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Inline Immediate Feedback in Arabic Web Forms: An Eye Tracking Study of Transactional Tasks

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Abstract—**Inline validation in web forms is essential when the complexity of fields in a form increases the likelihood that users would enter invalid or incorrect data, or to confirm appropriate answers. However, little is known about how users examine inline validation and how effective it is in supporting interaction in web transactional tasks. This paper describes an eye tracking study of web form interaction in which immediate inline validation is examined by analyzing user behavior as well as eye gaze patterns on Arabic web form fields for password entry. Findings suggest that web users exhibit sufficient visual attention on inline feedback, however users tend to respond more when the feedback is related error handling or warnings than when the feedback is a confirmation message. We conclude with design implications for the design of web forms.**

Keywords- Web forms; Eye tracking; Inline validation; Field Validation; Error handling; Confirmation messages

I. INTRODUCTION

Forms on the web facilitate the process of conducting transactions online. The design of such forms is crucial to the success of web transactions [1]. In recent years, design guidelines specializing in web forms have been proposed by researchers and practitioners. While some have been supported by a body of empirical evidence, a large portion of these guidelines are based on best practice reported by web designers and HCI practitioners (e.g. [5] and [10]) as noted by Javier Bargas-Avila et al. in [3].

Types of user interactions on the web have been categorized by Broder as informational, navigational and transactional tasks. The focus of this study is on transactional tasks in which users fill out web forms in return for a service from the site. In transactional tasks, the goals of users are often 'obtaining the service' such as registering, contact/feedback, or purchasing items rather than 'filling out the form'. Therefore, it is essential that the design of these forms is intuitive, usable, and user-friendly. This is to guide users through the process with minimal errors and supporting users effectively when obstacles are encountered in the transaction.

Web form design has been examined in HCI research with various focus areas such as label placement in forms [15], layout optimization on web forms [7], content of the web forms [17], types of input methods (i.e. form controls) [11], form submission methods [12], and ways of handling errors in forms (e.g. [2, 11]). Immediate feedback design issues are within the scope of error handling in web forms. There is an ongoing debate as to whether immediate feedback is effective in supporting users in their interaction with web transactional tasks. Guidelines for web form design recommend the use of immediate error handling in web forms for entries that are incorrect [9]. Furthermore, guidelines proposed by Neilsen [13] and Wroblewski [18] emphasize the importance of immediate feedback especially for fields that involve complex responses or answers that have high probability of being erroneous from target users. However, research conducted by Bargas-Avila et al. has suggested that inline validation is not effective in attracting the users' attention [2]. Their empirical studies have shown that users ignore immediate feedback. They have argued that their findings are not in conflict with ISO recommendations but rather show that users ignore them in the initial mode of completing forms, which they refer to as the 'completion mode', but consider them in the 'revision mode' of interacting with the forms. Their work has raised the question of whether designers and developers should consider immediate inline validation messages when users tend to ignore them or simply present them after completion of the form when users are ready to submit the form.

The growing body of research on immediate feedback has provided evidence to suggest the positive aspects of this method as reported by best practice in web form design, while at the same time has presented evidence to suggest that users actually ignore inline validation in the *completion* mode of transactional tasks and only consider them in the *revision* mode of interaction with web forms. Previous studies did not examine how users' responses differ according to the type of message. The scarcity of empirical evidence for this design issue has motivated us to examine this in a series of eye tracking studies.

This study examines the effectiveness of immediate feedback in supporting users in transactional tasks by considering visual attention on inline validation messages presented to users. The method of investigation is eye tracking users in their interaction with web forms in the context of Arabic interfaces. The research questions of this study are: How do users perceive different types of immediate feedback? Do users willingly ignore immediate feedback in the completion mode and revision mode of web transactional tasks? And, do users not see immediate feedback in the

completion mode and revision mode of web transactional tasks?

The paper is organized as follows: Section 2 provides a background on web form design and eye tracking research in this domain. Section 3 describes an exploratory study examining inline validation on Arabic web forms. Section 4 describes an experimental eye tracking study investigating the effectiveness of inline validation in attracting users' attention and supporting them in completing web forms. We conclude with design implications in Section 5 and future work.

II. Related Work

A. Designing web forms

Web form design issues have been examined at the three layers proposed by Caroline Jarrett in [10]; the appearance, conversational, and relationship layers. For the appearance layer, researchers have proposed evidence-based design guidelines for optimal layouts, label placement (e.g. [11] page 125) and format specifications for fields within the forms [4]. For the conversational layer, guidelines concerned with clarifying the meaning of questions by considering the language and placement (e.g. grouping) of form segments have been reported in [11] and [12]. For the relationship layer, research on issues related to form completion and abandonment and the importance of persuading users of these forms to properly complete the transaction has proliferated with the growth of services being offered online in financial, educational, and government sectors. The impact that design issues have financially or otherwise on organizations have led to guidelines for helping users to successfully interact with transactional forms on the web.

B. Immediate feedback

Design guidelines have recommended immediate feedback for users on web forms. These have been recommended by the ISO in their 9241 usability standards [9]. Validating as early as possible in transactional tasks was also a key recommendation in [11] (page 113) and in [18]. More recently, Wroblewski had suggested that designers consider inline validation for web form segments which do not have answers that can be perceived as obvious by users. His study showed that the users were more efficient and effective in completing forms when inline feedback was provided. However, these recommendations have been investigated by [2] who have shown that users actually ignore the inline validation. That evidence was based on examining the video sessions of participants in their studies.

Although both researchers and practitioners agree to the added value of immediate feedback in user interaction with web transactional tasks, prior research has shown that immediate feedback is not desirable in contexts where it interrupts the 'conversational flow', as pointed out by Jarrett **Error! Reference source not found.**[11], of the form during the completion mode of interaction with web forms.

Types of immediate feedback have been categorized by Wroblewski as confirmation, suggestion, and limit types [18]. Confirmation feedback on web forms involves inline messages such as the ones in Figure 1 confirming that the user had entered the email correctly. Eye fixations are overlaid as circles varying in sizes relative to their duration on the form segment. In this particular example, the user did not intentionally direct any visual attention to the confirmation messages which could mean that he/she ignored the message or was able to detect it with peripheral vision.

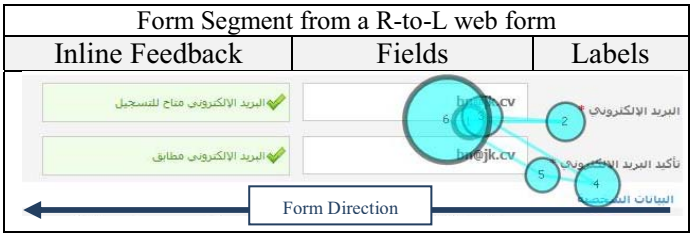


Figure 1 Confirmation-type of inline immediate feedback

Suggestion-type of validation includes presenting a set of valid answers to users for them to consider. An example is shown for the Saudia airlines' website where selecting the departure and arrival airports are from a set of specific valid answers. The user starts by typing the first letters of the city and the form immediately displays a list of valid answers that users can choose from.

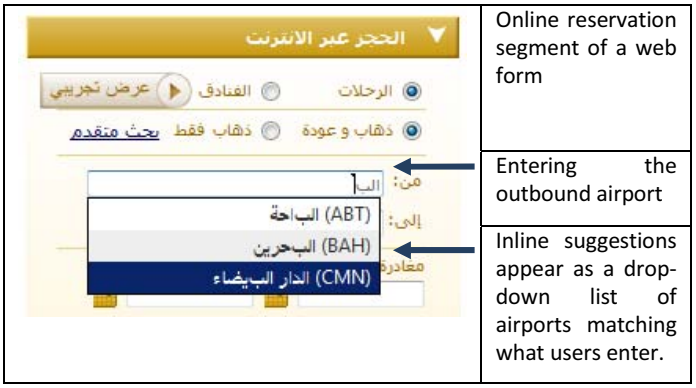


Figure 2 Suggestion-type inline immediate feedback

The third type of inline feedback is the limit type in which pre-defined limits for field entries are provided real-time as users complete the form. For example, Figure 3 shows the comment field on an Arabic form which has a 2000 character limit and the input field shows a real-time count of the number of characters entered by the user so as to avoid potential errors of exceeding limits.

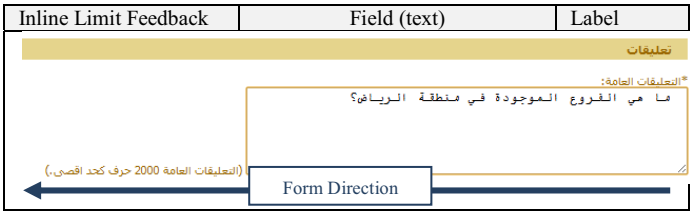


Figure 3 Limit-type inline immediate feedback

C. Eyetracking insights for design

Considering the importance of immediate feedback in web form design, there is scarcity in empirical research examining how users perceive this interaction method on web forms and

the effectiveness of such type of feedback from the perspective of users. While [2] examined user behavior and concluded from video records of session that users ignored immediate feedback, this has not been previously examined with eye tracking to see whether users actually saw the inline feedback and willingly ignored it or whether they did not see it all.

Eye tracking provides an insight to what users see in their interaction with interfaces and can provide researchers with objective measures of visual attention. Eye tracking studies examining web form design issues have been reported by Wroblewski [18], Penzo [15], Neilsen [14], and Jarrett [10-11]. While most of the web form design research involved English interfaces, astonishingly little empirical research has been conducted on web form design in Arabic interfaces [1].

D. Immediate feedback in password fields

On most websites, passwords form the only line of defense even though they provide weak security. Moreover, to create a strong and secure password, it should be long and complex and it should be memorized by the user. This produces what is known as the password paradox: "although lengthy and complex passwords should be used and never written down, it is very difficult to memorize these types of passwords" [6]. However, in practice, although some users are aware of the importance of complex passwords, they tend to use simple ones. The study in [16] concluded that most users don't create passwords which differ in complexity for each site. Moreover, the users use lower-case letters, digits, and personal information, which are the characteristics of weak passwords **Error! Reference source not found.**[6], to create their passwords. In a further study [8], the authors came to the conclusion that a large amount of users' passwords are of poor quality.

The above studies reveal to us the fact that users may not look at the password strength message due to their prior experience and knowledge of the strength of their passwords. Furthermore, when users check the password strength message and don't tend to change it could be the result of the password paradox, although they are aware of the importance of strong passwords, they traded it off with easy-to-remember passwords.

III. EYETRACKING INLINE VALIDATION IN ARABIC FORMS

An exploratory experiment for examining user interactions in web transaction tasks, described in [1], provided evidence from eye tracking that revealed patterns of user behavior on inline feedback on web forms. Eye gaze of participants was recorded using the Tobii X120 eye tracking device and web stimuli were displayed on an LCD monitor.

Findings of that exploratory study suggest that immediate feedback attracts users' attention although it did not always lead to immediate actions by the users as some users postponed correction till the end of the form. This was in line with findings of [2] in that users tend to ignore feedback in the *completion* mode of interacting with forms and are more likely to consider it in the *revision* mode of interaction. In the exploratory study described in [1], 50% of the participants scanned their entered value and visually examined the immediate inline feedback to determine whether there was an error message provided by the web form as shown in Figure 4.

Inline Error message: Password is too short

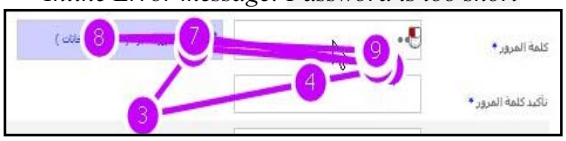


Figure 4 Visual attention on inline immediate error feedback

For feedback indicating an error, it was found that 40% of participants visually scanned the message. However, when the feedback was only a confirmation of correctly entered data, only 30% exhibited visual attention on the inline message of the form. An example of the latter is shown in Figure 5.

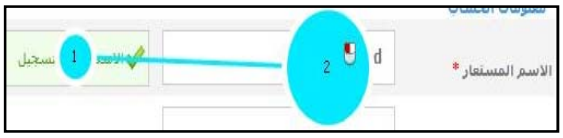


Figure 5 Visual attention on inline immediate confirmation

For cases where the system feedback was not clear for users, the steps of examining the data entered and the inline feedback from the form were cyclic and were repeated more than one time. This was reflected on their behavior and it was evident in exhibiting more fixations or longer fixation durations; long scans on the field and label in attempts to try to understand this issue and determine the source of the error as shown in Figure 6.

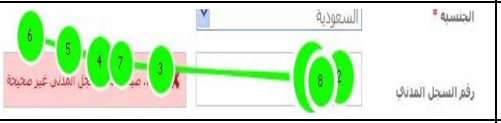
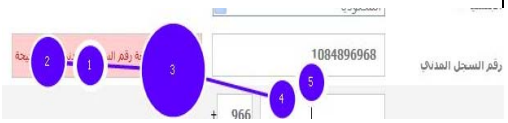
Gaze on immediate feedback for errors in ID	Pattern
	Increase in *number* of fixations
	Increase in *intensity* of fixations

Figure 6 Consecutive errors and inline validation messages

IV. EXPERIMENTAL INVESTIGATION OF ARABIC WEB FORMS

An eye tracking study was conducted in 2010 to examine transactional tasks in Arabic web forms. The study observed users in their interaction with various web forms by logging their interaction (e.g. key strokes, mouse movements, navigation paths), recording their eye gaze as they fill-out the form online, and recording what they say about their interaction in a post eye tracking think-aloud protocol (PEEP), in which the eye gaze of participants is replayed to them while they describe problems and obstacles they faced during their interaction. For the scope of examining the effectiveness of inline immediate feedback, we focus our analysis on web forms that had immediate feedback for password selection; the

Arabic version of the Yahoo registration form. Measures of effectiveness were visual attention and response by participants because based on findings of [2], it was shown that time was not significant in differentiating between different forms of inline feedback whereas behavioral measures of interaction (attention and action) were indicators of effectiveness.

A. Overview of Experiments

Thirty participants took part in the study. Participants ranged in age from 14 to 42 years. Participants had a range of computer experience from 4 to 15 years, and their experience in using the Internet was similarly between 4 to 15 years. All of the participants had prior experience in interacting with web forms. Stimuli presentation was counterbalanced to control for learning effects. Participants were tested individually in session ranging between 20-40 minutes with an average duration of 30 minutes.

B. Stimuli

The Yahoo sign up page shows immediate feedback on some of its fields. The Password field was chosen to examine the immediate feedback. Figure 7 shows the immediate feedback types provided by Yahoo's registration form for password selection along with the number of occurrences of these cases in the sample for participants who exhibited visual attention on the messages (23 out of the 30).

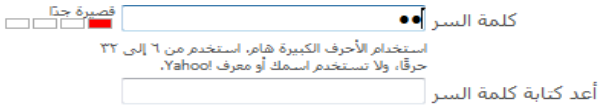
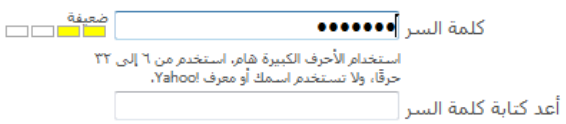
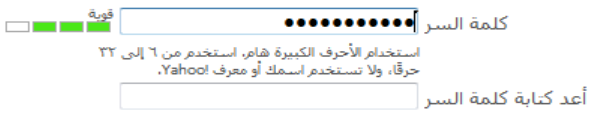
Case Description	No. of Cases
Password entered is incorrect	3
 Double ***visual*** emphasis: 1. **Red** color & ¼ Bar indicator 2. Text message "password is too short"	
Password is correct, but the strength is not high	12
 Double ***visual*** emphasis: 1. **Yellow** color & 2/4 Bar indicator 2. Text message "password is weak"	
Password is correct, strength of password is high	8
 Double ***visual*** emphasis: 1. **Green** color & 3/4 or 4/4 Bar indicator 2. Text message "password is strong"	

Figure 7 Inline feedback type on password's strength

Three types of messages appear to describe the state of the password entered by users. Placement of the inline feedback was on the left side of the entry field, informing users of the detected problem and/or strength level. *Double visual emphasis* in feedback, a term coined by [18], was used in these forms to indicate the validation result of the entered values. When the password is short, red lines appear along with a message explaining why the password was not accepted. When the password is weak (e.g. hackers may be able to break into a client's Yahoo email account), a warning message with yellow lines appears but the password is acceptable by the form if the user decides to ignore the warning. The third message shows that the password is strong and is also acceptable. In recovering from these errors or responding to warnings, users can determine the strategy to change the state by scanning the field itself or scanning field instructions again.

C. Analysis

In the sample examined for this interaction, one participant had limited eye movement data captured and was not included in this analysis. Visual attention on inline feedback was exhibited by 79.3% of the sample; 20.7% of the total participants didn't scan the messages and were thus excluded from the visual attention analysis. These participants indicated in the PEEP protocol that they already knew that their entered password was of the strongest level from prior experience with similar fields on forms. For the participants who exhibited visual attention on the form's inline feedback, behavioral analysis was conducted to examine their response in this 'completion mode' of interaction. The participants' responses to the field's state are shown in
Table 1. The numbers in the table reflect the number of participants who scanned the messages and their actions (i.e. participants who did not scan the message were not counted here). In revision mode, all participants neither scanned the feedback nor changed their passwords.

Table 1 Participants' responses to password field messages in the completion mode

Case	*Participant response*	*Number of participants*
Password is weak	Try to change the password and then scan the new message	3
	No action	9
Password is strong	Try to change the password and then scan the new message	0
	No action	8
Password is wrong	Try to change the password and then scan the new message	3
	No action	0

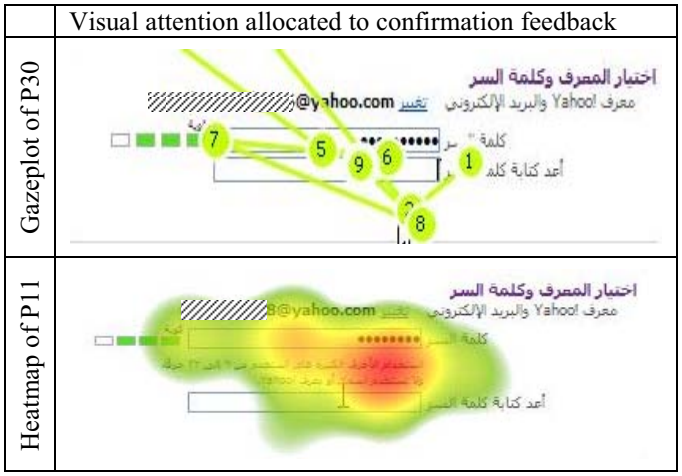


Figure 8 : Examples of participants scanning strong password feedback

D. Visual Attention

Gaze plots of visual patterns in the cases described in

Table 1 show the sequence of fixations exhibited on the inline feedback. Figure 8 shows an example of the pattern exhibited by participants who glanced at the inline feedback before moving on to the next field on the web form.

Participants also accepted the state and moved to the following field when the password was weak indicating that it was acceptable to the participant, and they decided willingly to move on and ignore the warning of a weak password. An example is shown in Figure 9 for a participant who ignored the warning completely. This behavior of intentionally ignoring the warning can be explained by the password paradox problem described in section II or by simply having users focused on proceeding in the *completion mode* and considering the revision tasks in the revision mode of completing the form. In the revision mode, it was found that revising the weak password in these cases was not considered. This behavior could be explained by habitual interaction in that users often tend to ignore password strength warnings or by the possibility that users were not motivated in this experimental artificial setting of web interaction to respond as they would in real contexts of interacting with web forms.

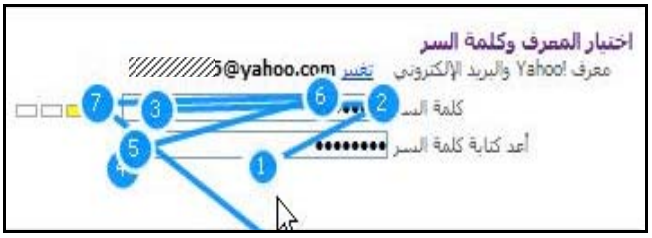


Figure 9 Gazeplot of visual attention on a warning without responding

For cases in which the participants responded to immediate feedback by taking action immediately, participants tended to reiterate between the data entry field and the message especially if consecutive errors or warnings persisted. Figure 10 shows an example of the visual pattern exhibited in that scenario; the heat map shows visual attention distribution for a participant noticing the warning and directing attention back to the field, and in the 2nd cycle of responding tried changing the password but still found that the form was indicating the she was providing a weak password after which she chose to ignore the warning and move on to the next field in the web form. Intensity of visual attention in this heat map was higher on the inline feedback than the field itself.

Figure 10 Heat map of attention on inline feedback and data entry field

The participants in Figure 11 tried to change the state when the system indicated that their password was wrong or weak and tried to correct it and exhibited a consecutive revision of scanning the message again.

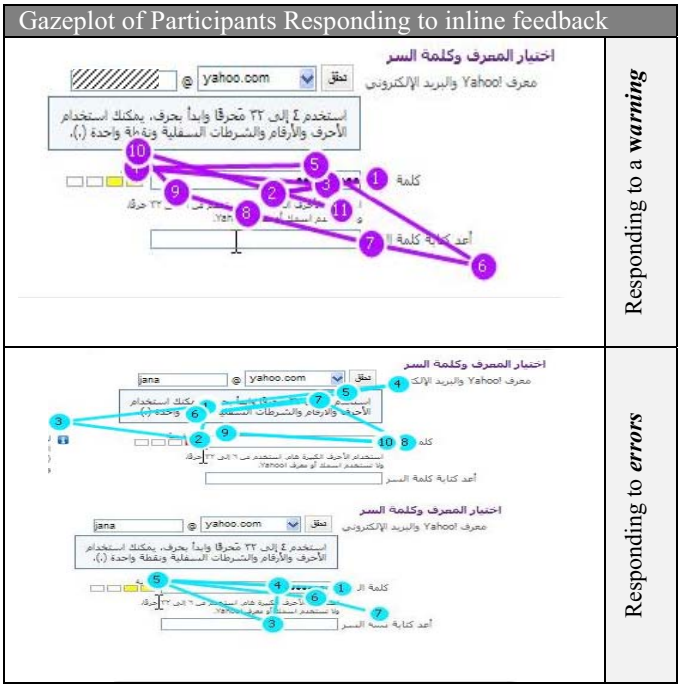


Figure 11 Visual attention and responses to inline immediate feedback

V. CONCLUSION

Although the method of presenting error messages to users is important for web form design, it has received very little attention in empirical HCI research. This study contributes to

the empirical research of web form design for examining effective ways of presenting inline message. The main focus of this research was visual attention on inline feedback obtained with eye tracking. Findings show that users who exhibit visual attention to inline feedback on web forms are more than web users who ignore inline feedback. Furthermore, we found that users often respond to inline feedback in the completion mode of transactional tasks if the feedback is related to errors in the data entry field. However, in cases where the inline feedback involves warnings not critical to the completion of the form, it was found that users tend to ignore the inline feedback even though it had attracted visual attention during the flow of completing the form. These findings have implications for the design of web forms in supporting the design guidelines for including immediate inline feedback in web forms especially for the case of error handling. However, the case for inline feedback related to non-critical communication with users (e.g. warning or confirmation) had mixed results and thus warrants further study. Further studies are being conducted to examine the user interaction with immediate inline feedback in the revision mode especially with warning messages, and examining the difference in user behavior when the forms provide immediate feedback or not by using eye tracking.

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